US Application number :	10/553,597
Inventor:	Alain TOURNIER, et al.
Assignee:	Saint-Gobain PAM
Group art unit:	1792
Filed:	October 18, 2005
For:	Flame coating method and corresponding device

DECLARATION

We, the undersigning, Alain TOURNIER and Denis GIRARDIN, are co-inventors of the present patent application, together with Michel CHEZEAU and Alain SECONDY, and hereby declare the following:

1. Educational background

a) Alain Tournier

1974: certificated Engineer of the "Ecole Nationale des Industries Chimiques" (Nancy, France),
1978: Engineer-Doctor in Chemical Engineering of the "Institut National Polytechnique de Lorraine" (Nancy, France),
1982: Ph. D in Chemistry of the Poincaré University (Nancy, France)

b) Denis Girardin

1986: certificated Engineer of the « Ecole Nationale Supérieur d'Arts et Métiers (ENSAM) » in France
1992: Doctor of materials science of the University of Nancy I (France)

2. Professional experience

a) Alain Tournier

1983 – 1991: manager of a department in the Research Centre of Saint-Gobain PAM: I was in charge of the Physics and Modeling Department with the objective to develop new processes for the manufacture of cast iron pipes,
1991 – 1999: Director Assistant of the Research Centre of Saint-Gobain PAM
From 1999: Director of the Development and Research Centre of Saint-Gobain PAM

b) Denis Girardin

1986 – 1989: thesis work in the joint laboratory of the CNRS (French National Center for Scientific Research) and Saint-Gobain. The subject concerned a plasma device for producing ultrafine metallic powders.
1989 – 1997: Research Engineer at Saint-Gobain PAM. During this period I developed a lot of abilities in metallurgical processes and made three inventions which have been patented.
From 1998: Research and Development projects manager at Saint-Gobain PAM and teacher at the University of Nancy (France). During this period three further inventions have been patented, including the present invention.

3. Invention

a) The present invention relates to a flame coating method and corresponding device. The claimed method and device refer to the reuse for flame coating of ZnAl-powder obtained by a coating method by projection.

b) Before the present invention was made, in the industrial environment in order to cover an object with a layer of ZnAl, a ZnAl wire was introduced in a burner. The burner heated the wire and liquefied the material of the wire. The such liquefied ZnAl was then projected onto the object to be covered.

This method is classically known as wire flame coating.

The major problem of this type of method is that up to 40% of the wire material does not adhere to the object to be covered and accumulates as waste powder. The waste powder was considered to be lost and needed to be disposed of, which created supplementary cost.

c) Parting from this problem, we conducted intensive research in order to improve the efficiency of the process.

In the first stage of our research, we tried to reconstitute a wire from the ZnAl waste powder. However, after a large number of experiments, it was impossible to transform the waste powder efficiently again into a wire that could be reliably used for wire flame coating.

In the second stage, we turned to experiments seeking to introduce the ZnAl waste powder into a plasma jet. These experiments also were fruitless as they led to evaporation of the ZnAl powder particles.

After countless experiments, in the third stage of our research, we finally turned to high velocity oxidant fuel flame coating (HVOF). HVOF is for example disclosed by Künzli. However, the device as disclosed by Künzli does not lead to the expected success either. Indeed, Künzli teaches introducing the spray material through radial bores 14. However, the bores 14 are arranged in a zone which is not at all adapted to ZnAl particles. Indeed, the bores 14 end in a zone of the flame that has a temperature that is far too high. Consequently, the particles melt already inside the bores and clog the bores. Hence, the burner disclosed by Künzli can not be used with ZnAl particles.

d) One major reason why it was believed that the ZnAl particles can not be reused in flame coating is due to an oxide layer on the outer surface of the particles. It was considered impossible to recycle the zinc-aluminium powder from spray coating methods for reuse in flame spray coating application. As show our countless experiments and different approaches indicated above, we needed to overcome a prejudice to arrive at the present invention. We found surprisingly that zinc-aluminium particles can be reused in flame spray application by simply introducing them in the right portion of the flame. This surprising discovery led to the present patent application, which we believe is a major technical improvement over the prior art and constitutes an important economical progress.

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We declare further that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of title 18 of the United State Code, and that such wilful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 4 Mars 2009

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